TAXONOMY OF THE PHYTOPLANKTON FLORA IN NORTHWESTERN LUZON, PHILIPPINES WITH NOTES ON THEIR ECOLOGY

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ABSTRACT

Phytoplankton were collected from the twelve (12) stations in Northwestern Luzon, Philippines starting from August 1981 and ending in June 1982. One hundred eight species belonging to two classes, three orders, nineteen families and thirty-nine genera were recorded.

Total phytoplankton abundance measured at each of the twelve (12) stations was correlated with abiotic ecological parameters. T-test showed a significant difference in phytoplankton cell count between the peak of dry and wet seasons in only one of the twelve stations. On the other hand, analysis of variance showed a significant difference in the phytoplankton cell count during the six collecting periods at three stations which are also exceptionally good fishing areas.

Correlation and stepwise regression showed a correlation between cell count and all five physico-chemical factors measured (temperature, salinity pH, nitrate and phosphate concentrations) at just one station. Eight of the stations showed a correlation between one and four factors. The topography of the sampling areas coupled with other factors such as wind and water currents accounted for profuse or scanty phytoplankton population.

INTRODUCTION

Phytoplankton are minute, floating autotrophic plants that build up their protoplasm and food reserves out of light, carbon dioxide and salts in solution such as phosphates and nitrates. They offer little or no resistance to the currents and thus, live free floating and suspended in open or pelagic waters.

In spite of their minute size, they are an important adjunct to our marine flora since they can be used as indicators of water quality. They are now thought to be of great importance as a source of food for many microphagous organisms Newell and Newell, 1967) and, therefore, they are useful in the production of basic food for the ecosystem. Pollution stress is likewise, indicated mainly by the population structure and the succession of phytoplankton species.

The meager knowledge on phytoplankton from the Philippines has stimulated the researcher to study the phytoplankton flora and distribution in Northwestern Luzon and to assess the ecological factors affecting the phytoplankton cell count.

MATERIALS AND METHODS

The provinces of Northwestern Luzon facing the China Sea which include Batanes, Ilocos Norte, Bataan, Metro Manila, Cavite, Batangas, Oriental and Occidental Mindoro are situated at latitude 21° to 125°N and longitude 117° to $122\text{-}124^{\circ}$E. A total of twelve stations constitute the floristic study areas for marine phytoplankton (Fig. 1). Thus, Basco is the station situated in Batanes; Burgos in Ilocos Norte; Sta. Maria in Ilocos Sur; Agoo in La Union; Sual in Pangasinan; Sta. Cruz in Zambales; Orion in Bataan; Manila bay in Metro Manila; Noveleta in Cavite; Balayan in Batangas; Calapan in Oreintal Mindoro and finally San Jose in Occidental Mindoro.

The materials for the plankton investigation were collected every week-end (Saturday and Sunday) of each of six collecting months starting in August 1981 and ending in June 1982 namely August, October, December 1981 and February, April and June 1982. The month indicating the peak of dry season as well as wet season was likewise considered. Based on the records provided by the Climatological Division of Philippine Atmospheric Geophysical and Astronomical Services Administration (PAGASA) April is the driest month whereas August is the wettest month for Batanes, Ilocos Norte, Ilocos Sur, La Union, Pnagasinan, Zambales, Bataan, Metro Manila, Cavite and Batangas; and October for Mindoro.

The plankton net was towed in a depth of about one meter more or less from the surface of the water with the aid of a banca each time collections were done from the twelve stations. Each station was divided into three substations in order to get a representative sample from the said station.

Forty-eight (one liter) glass bottles with cork stoppers were used as containers for water samples. Four bottles were allotted per station, three of these serving as containers of the phytoplankton while the fourth as container of the water sample for testing such factors as pH, turbidity and the amount of phosphates and nitrates.

A pH meter was used to determine the hydrogen ion concentration. The salinity meter (Yellow Spring Incorporated model 3) was utilized to find out the sodium chloride content of marine water expressed in parts per thousand (ppt) as well as its temperature in Celsius degree. The weight of suspended solids given in forma turbidity units (FTU) and the concentration of phosphates and nitrates in ppm were measured by means of a D-R spectrophotometer.

A five percent (5%) solution of commercial formalin was used to preserve the phytoplankton. Forty (40) ml of buffered formalin was added to one liter of the sample immediately after collection. Samples were stored in the dark to retain the color of the preserved plankton. Some of the samples were examined alive by storing them first in a refrigerator and examining them within three (3) hours of collection in order to become familiar with the live specimens and to examine any distortions brought about by preservatives. The organisms contained in water samples were concentrated in the laboratory before analysis. The method utilized for counting phytoplankton was by the total cell count method wherein the basis in enumerating organisms was the number of cells per ml.

RESULTS

A. Taxonomy

This work includes two (2) phyla, two (2) classes, three (3) orders, nineteen (19) families, thirty-nine (39) genera and one hundred eight (108) species as shown below. Voucher specimens for phytoplankton identification are kept in the De La Salle University Department of Biology where the researcher is connected with.

TAXONOMIC CLASSIFICATION OF THE MARINE PHYTOPLANKTON IN NORTHWESTERN LUZON, PHILIPPINES

Phylum Chrysophyta

Class Bacillariophyceae

Order Centrales

Family Bacteriastraceae

I. Genus *Bacteriastrum* Shadbolt

B. delicatulum Cleve

B. haulinum Lauder

B. varians Lauder

Family Biddulphiaceae Lebour

II. Genus *Bellerochea* Van Heurck

B. malleus (Brightwell) H. Van Heurck

III. Genus *Biddulphia* Gray

B. Aurita (Lyngbye) Breb, et Godey

B. dubia (Brightwell) Cleve

B. mobiliensis Bailey

B. pulchella Gray

B. sinensis Greville

IV. Genus *Cerataulina* Peragallo

C. bergonii Peragallo

V. Genus *Ditylum* Bailey

D. sol Grunow

VI. Genus *Hemiculus* Ehrenberg

H. Sinensis Greville

VII. Genus *Triceratium* Ehrenberg

T. americanum Ralfs

T. favus Ehrenberg

Family Chaetoceraceae Schroder

VIII. Genus *Chaetoceros* Ehrenberg

C. affinis Lauder

C. coarctatus Lauder

C. compressus Lauder

C. convolutus Castracane

C. danicus Cleve

C. decipiens Cleve

C. densus Cleve

C. eibenii Grunow

C. laevis Leuduger, Fortmorel

C. lorenzianus Grunow

C. messanensis Castracane

C. paradoxum Cleve

C. pelagicus Cleve

C. peruvianus Brightwell

C. socialis Lauder

C. teres Cleve

Family Coscinodiscaceae Schroder

IX. Genus *Coscinodiscus* Ehrenberg

C. asteromphalus Ehrenberg

C. excentricus Ehrenberg

C. granii Gough

C. janesianus (Greville) Ostenfeld

C. nitidus Gregory

C. nobilis Grunow

C. oculus-iridis Ehrenberg

C. radiatus Ehrenberg

X. Genus *Planktoniella* Schutt

P. sol (Wallich) Schutt

Family Eucampiaceae Schroder

XI. Genus *Eucampia* Ehrenberg

E. zoodiacus Ehrenberg

Family Leptocylindraceae Lebour

XII. Genus *Leptocylindrus* Cleve

L. danicus Cleve

Family Melosiraceae Cleve

XIII. Genus *Melosira* Agardh

M. borreri Greville

Family Rhizosoleniaceae Schroder

XIV. Genus *Rhizosoleniae* (Ehrenberg) Brightwell

R. alata Brightwell

R. alata forma *gracillima* (Cleve) Grunow

R. alata forma *indica* (Peragallo) Ostenfeld

R. bergonii H. Peragallo

R. Calcar-avis M. Schultze

R. Castracanei H. Peragallo

R. fragilissima Bergon

R. hebetata forma *hiemalis* Gran

R. hebetata forma *semispina* (Hensen) Gran

R. robusta Norman

R. stoltherfothi H. Peragallo

R. styliformis Brightwell

R. styliformis var. *latissima* Brightwell

Family Skeletonemaceae Lebour

XV. Genus *Skeletonema* Greville

S. costatum (Greville) Cleve

Family Thalassiosiraceae Lebour

XVI. Genus *Lauderia* Cleve

L. annulata Cleve

L. borealis (Grunow) Gran

L. glacialis (Grunow) Gran

XVII. Genus Thalassiosira Cleve

T. subtilis (Ostenfeld) Gran

Order Pennales
Family Achnanthaceae

XVIII. Genus *Achnanthes* Bory

A. brevipes Agardh

XIX. Genus *Cocconeis* Ehrenberg

C. Scutellum Ehrenberg

Family Fragilariaceae Schroder

XX. Genus *Asterionella* Hassal

A. japonica Cleve

XXI. Genus *Fragilaria* Lyngbye

F. oceanica forma *typica* Cleve

XXII. Genus *Thalassionema* (Grunow) Hustedt

T. nitzschioides Grunow

XXIII. Genus *Thalassiothrix* Cleve et Grunow

T. freunfeldii Grunow

T. longissima Cleve et Grunow

Family Naviculaceae

XXIV. Genus *Navicula* Bory

N. elegans W. Smith

N. salinarum Grunow

XXV. Genus *Pleurosigma* W. Smith

P. affine Grunow

Family Nitzschiaceae

XXVI. Genus *Bacillaria*

B. paradoxa Gmelin

XXVII. Genus *Nitzschia* Hassal

N. lanceolata W. Smith

N. longissima (Breb.) Ralfs

N. seriata Cleve

Family Surirellaceae

XXVIII. Genus *Campylodiscus* Ehrenberg

C. ralfsii W. Smith

C. undulatus A. Schmidt

XXIX. Genus *Surirella* Turpin

S. cuneata A. Schmidt

Family Tabellariaceae

XXX. Genus *Climacosphenia* Ehrenberg

C. monaligera Ehrenberg

XXXI. Genus *Licmophora* Agardh

L. abbreviata Agardh

L. flabellata (Carm,) Agardh

XXXII. Genus *Khabdonema* Kutzing

R. adriaticum Kutzing

R. arcuatum Klitzring

XXXIII. Genus *Striatella* Agardh

S. unipunctata (Lyngbye) Agardh

Phylum Pyrrophyta

Class Dinophyceae

Order Peridiniales

Family Citharistaceae Kofoid et Skogsberg

I. Genus *Ceratum* Schrank

C. breve (Ostenfeld et Schmidt) Schroder

C. candelabrum (Ehrenb.) Stein

C. extensum (Gourret) Cleve

C.Furca (Ehrenb.) Dujardin

C. fusus (Ehrenb.) Dujardin

C. gibberum Gourret

C. kofoidii Jorgensen

C. longinum Karsten

C. macroceros (Ehrenb.) Cleve

C. massiliense (Gourret) Jorgensen

C.pentagonum Gourret

C. pulchellum B. Schroder

C. setaceum Jorgensen

C. sumatranum (Karsten) Jorgensen

C. teres Kofoid

C. tripos (O.F. Muller) Nitzsch.

C. vultur Cleve

II. Genus ***Ceratocorys*** Stein

C. horrida Stein

III. Genus ***Peridinium*** Ehrenberg

P. faltipes Kofoid

P. oceanicum Vanhoffen

P. parallelum Broch

P. pentagonum Gran

IV. Genus ***Pyrophacus*** Stein

P. horologicum Stein

Family Dinophysiaceae Pavillard

V. Genus ***Dinophysis*** Ehrenberg

V. homunculus Stein forma ***ventricosa*** Pavillard

Family Ornithoceraceae Kofoid et Skogsberg

VI. Genus ***Ornithocercus*** Stein

O. serratus Kofoid

B. Phytoplankton Cell Count and Local Distribution

Data in Table 1 show a significant difference in the phytoplankton cell count only in Orion, Bataan since the computed t-value (2.84) is greater than the tabular value (2.145) at .05 level.

Results in Table 2 show no significant difference in the phytoplankton cell count in the twelve stations per collecting month using one-way analysis of variance. However, comparison of the phytoplankton cell count every collecting month per station reveals a different pattern as shown in Table 3. The data show a significant difference in phytoplankton cell count every collecting month only in Sta. Cruz, Zambales, Noveleta, Cavite and Calapan, Oreintal Mindoro since the corresponding f-value (5.58, 3.73 and 4.35) is greater than the tabular value (2.35, 2.40 and 2.30) respectively at .05 level.

C. Ecological Factors

1. Physical Factors

a. Water temperature

From August 1981 up to June 1982, variation in recorded temperature at a depth of one (1) meter more or less ranged from 1 to 10°C as shown in Table 4. Minimum temperature was 21°C in San Jose, Occidental Mindoro during the August collection. Maximum temperature was 34°C in Manila Bay during the October collection.

b. Turbidity

The presence of suspended solids amounting to 10 FTU (forma turbidity units) was noted in the water sample taken from Manila Bay during the month of February as presented in Table 4-8. The rest of the water samples contained no sediments as evidenced by the zero (0) value in the D-R spectrophotometer.

2. Chemical Factors

a. Salinity

Salinity values rose from 19 to 24.5°/oo between August and October 1981; 15 to 29.5°/100 between December 1981 and February 1982; 25 to 32°/100 between April and June 1982 as indi- 26, 1981 in Basco, Batanes and Manila Bay respectively while a high value of 32°/00 was recorded on April 24, 1982 in Balayan, Batangas.

b. pH

Data on pH values were summarized in Table 4 ranging from slightly acidic (6.5) during the October 1981 collection in Sual, Pangasinan to slightly basic (8.3) during the February and June 1982 collections in Burgos, Ilocos Norte; Sta. Maria, Ilocos Sur; Agoo, La Union and Sta. Cruz, Zambales.

c. Dissolved Inorganic Phosphate and Nitrate

Values ranged from below 0.01 to 0.15 ppm phosphate and below 0.01 to 26.4 ppm nitrate during August and October 1981; 0.01 to 1.6 ppm phosphate and 0.88 to 114.4 ppm nitrate during December 1981 and February 1982; 0.2 to greater than 2 ppm phosphate and 9.68 to 19.80 ppm nitrate during April and June 1982 collections. All stations showed a marked increase in the amount of phosphate for the June 1982 collections except that of Manila Bay. Greater than 2 ppm was so far the highest figure incurred during the month of June as against 0.4 ppm for Manila Bay. The amount of nitrate was the lowest (0.01ppm) in October 1981 and the highest (114.4 ppm) in December 1981.

Table 5 shows that nitrates and phosphates (.894) were the variables significantly affecting the phytoplankton cell count in Basco, Batanes using correlation and stepwise regression. In Burgos, Ilocos Norte, aside from nitrates and phosphates (.910), temperature (.834) was the additional factor to be taken into account. In Sta. Maria, Ilocos Sur and Agoo, La Union nutrients like nitrates and phosphates (.962) & .894) were likewise the factors worth mentioning. But in Sta. Cruz, Zambales, temperature (.894), salinity (.863), pH (.894), nitrates and phosphates (.931) had been shown to be correlated with the total cell count. All the factors mentioned minus the temperature were for Orion, Bataan; pH (.924) and phosphates (.970) for Manila, Metro Manila and Calapan, Oriental Mindoro and only nitrates (.847) for Noveleta, Cavite. However, the phytoplankton cell count in Sual, Pangasinan, Balayan, Batangas and San Jose, Occidental Mindoro were not correlated to any of the aforementioned factors as shown by the r-value which was less than .811.

DISCUSSION

The marine phytoplankton identified in each of the twelve stations studied are summarized in Table 6.

Data on ecological factors show that salinity (19 ppt) was subject to dilution by rainfall. The amount of nitrates (0.044 ppm) and phosphates (below 0.01 ppm) was minimal but the phytoplankton cell count in Bataan station was greater during the month of August than April with *Skeletonema costatum* dominating the group. Odum (1971) states that the low concentration of nutrients does not necessarily indicate total scarcity since these materials are in such "demand" by organisms that efficiently take thme out of circulation as rapidly as they are released.

The amount of nitrates (13.2 ppm) and phosphates (0.35 ppm) for April was greater than that of August at the same time that the phytoplankton cells of August outnumbered those of April. The presence of a greater number of nutrient uptake could explain the lower amount of nitrates and lack of detectable phosphates in the water. In spite of the fact that the number of phytoplankton cell count was greater in August/October 1981 than in the April 1982 collection, statistics show that the difference was not significant in the remaining eleven stations during the peak of wet and dry seasons.

The abundance of phytoplankton during the peak of wet season in all stations could be attributed to wind and current associated with that time of the year. August and October 1981 were characterized by unusual storm activity in Northwestern Luzon (unpublished data from PAGASA, the national weather service).

Converging water currents or eddies also helped to concentrate the phytoplankton in certain places. This phenomenon was exemplified in station 6 (Sta. Cruz, Zambales), station 7 (Noveleta, Cavite) and station 11 (Calapan, Oreintal Mindoro) wherein abundance in phytoplankton was felt during the months of June and August while scarcity was conspicuous during the months of October, December and February Warm temperature (29°C and 32°C) of August 1981 and June 1982 was more preferred by phytoplankton than low temperature (27°C) of December 1981 and February 1982 in the aforementioned places (stations 6, 7 and 11). Salinity readings during the months of

June $(29.5^{o}/00)$ and August $(24^{o}/00)$ were higher than of October $(23.5^{o}/00)$ and December $(16^{o}/00)$ in Sta. Cruz, Zambales and Noveleta, Cavite. A slightly basic environment accompanied better phytoplankton growth. The increased amount of nutrients such as nitrates and phosphates during the month of June resulted not only in phytoplankton increase but also in greater species diversity. The topography of Sta. Cruz, Zambales, Orion, Bataan, Noveleta, Cavite and Calapan, Oriental Mindoro played a major role in increased phytoplankton cell count owing to their protected position from wind, waves or currents. As a consequence, they are considered good fishing areas of the country.

Scarcity of phytoplankton was likewise manifested in station 1 (Basco, Batanes) station 3 (Sta. Maria, Ilocos Sur) and station 12 (San Jose, Occidental Mindoro) during the months of October, December and February. In these stations, the amount of nutrients was very low which could be due to active nutrient uptake by the phytoplankton.

SUMMARY AND CONCLUSIONS

1. The phytoplankton of Northwestern Luzon is represented by one hundred eight species of algae belonging to two (2) phyla, two (2) classes, three (3) orders and thirty-nine (39) genera.

2. A significant difference in the phytoplankton cell count during the peak of dry and wet seasons was found only in Orion, Bataan using t-test.

3. A significant difference in the phytoplankton cell count every collecting season was found in Sta. Cruz, Zambales, Noveleta, Cavite and Calapan, Oriental Mindoro using one-way analysis of variance.

4. The parameters such as (a) nitrates and phosphates affecting the phytoplankton cell count in Basco, Batanes; Sta. Maria, Ilocos Sur ang Agoo, La Union; (b) temperature, salinity, pH, nitrates and phosphates in Sta. Cruz, Zambales; (c) all factors except temperature in Orion, Bataan; (d) temperature, nitrates and phosphates in Burgos, Ilocos Norte; (e) pH and phosphates in Manila, Metro Manila and Calapan, Oriental Mindoro and (f) only nitrates in Noveleta, Cavite were shown by using correlation and stepwise regression.

5. A great variety in species composition in the sampling areas during the June collection was attributed to higher amount of nitrates and phosphates, warm temperature, salinity and slightly basic environment.

6. The topography of Sta. Cruz, Zambales, Orion, Bataan, Noveleta, Cavite and Calapan, Oriental Mindoro was also a factor to make them exceptionally good fishing areas.

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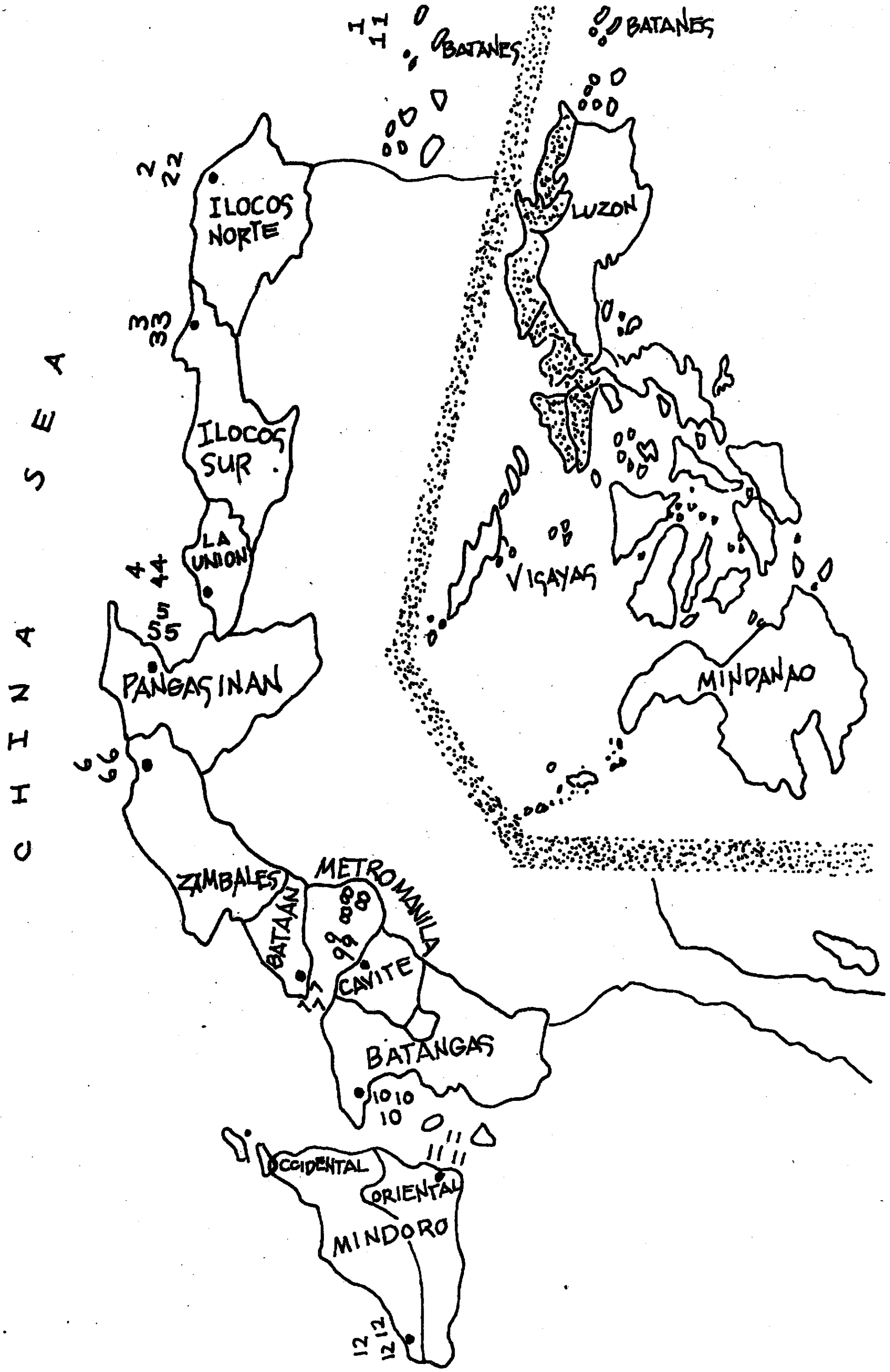

Figure 1. Map showing the different collecting sites.

Table 1

Summary Table of t-test showing t-value of Phytoplankton Cell Count Per Station

Station	t-value	Tabular Value (.05)
1. Basco, Batanes	0.96	2.080
2. Burgos, Ilocos Norte	1.18	2.120
3. Sta. Maria, Ilocos Sur	0.17	2.086
4. Agoo, La Union	0.26	2.080
5. Sual, Pangasinan	0.93	2.052
6. Sta. Cruz, Zambales	1.69	2.101
7. Balayan, Batangas	0.63	2.145
8. Noveleta, Cavite	1.62	2.306
9. Manila, Metro Manila	1.19	2.131
10. Orion, Bataan	2.84*	2.145
11. Calapan, Oriental Mindoro	1.06	2.060
12. San Jose, Occ. Mindoro	1.28	2.042

Table 2

Summary Table of One-Way Analysis of Variance Showing f-value of Phytoplankton Cell Count Per Collecting Month

Collecting Month	f-value	Tabular Value (.05)
1. August 1981	1.34	1.86
2. October 1981	1.05	1.88
3. December 1981	0.72	1.93
4. February 1982	1.08	1.94
5. April 1982	1.14	1.91
6. June 1982	1.22	1.83

Table 3

Summary Table of One-Way Analysis of Variance Showing f-value of Phytoplankton Cell Count Per Station

Station	f-value	Tabular Value (.05)
1. Basco, Batanes	0.42	2.48
2. Burgos, Ilocos Norte	0.55	2.43
3. Sta. Maria, Ilocos Sur	0.12	2.40
4. Agoo, La Union	0.51	2.37
5. Sual, Pangasinan	0.38	2.33
6. Sta. Cruz, Zambales	5.58*	2.35
7. Balayan, Batangas	0.39	2.33
8. Noveleta, Cavite	3.73*	2.40
9. Manila, Metro Manila	0.69	2.41
10. Orion, Bataan	1.18	2.36
11, Calapan, Oriental Mindoro	4.35*	2.30
12. San Jose, Occ. Mindoro	0.28	2.35

Table 4. Ecological Factors In The Collecting Stations During The Different Sampling Periods.

1. Basco, Batanes

Ecological Factors	Aug. 1	1981 Oct. 3	Dec. 5	Feb. 6	1982 Apr. 3	June 5
Temperature °C	31	28	26	27	31	29
Salinity ppt	23	22	15	26	31.5	31
pH	7.9	8.0	7.9	7.8	7.9	7.9
Turbidity FTU	0	0	0	0	0	0
Nitrate ppm	0.44	0.44	13.2	0.88	17.6	132
Phosphate ppm	0.01	0.01	1.12	0.01	0.5	K2

2. Burgos, Ilocos Norte

Ecological Factors	Aug. 8	1981 Oct. 10	Dec. 12	Feb. 13	1982 Apr. 10	June 12
Temperature °C	28.5	30	23	27	28.5	30
Salinity ppt	23	24.5	17	26	31.5	26
pH	7.95	7.0	7.85	7.8	8.1	8.3
Turbidity FTU	0	0	0	0	0	0
Nitrate mg/1	0.88	Z0.01	114.4	0.88	17.6	26.4
Phosphate mg/1	0.04	0.01	0.7	0.01	0.5	X2

3. Sta. Maria, Ilocos Sur

Ecological Factors	Aug. 9	1981 Oct. 11	Dec. 13	Feb. 14	1982 Apr. 11	June 13
Temperature °C	32	30.5	30	28	31	30
Salinity ppt	22	24	16	27	30	27
pH	7.9	7.0	8.0	7.8	8.1	8.3
Turbidity FTU	0	0	0	0	0	0
Nitrate mg/1	0.88	Z0.01	26.4	0.88	19.8	52.8
Phosphate mg/1	0.06	0.01	0.7	0.01	0.25	X2

4. Agoo, La Union

Ecological Factors	Aug. 15	1981 Oct. 17	Dec. 19	Feb. 20	1982 Apr. 17	June 19
Temperature °C	22	30	23	27	30	30.5
Salinity ppt	21	23	18	28	30.5	29.5
pH	7.9	8.2	7.85	8.3	8.0	8.2
Turbidity FTU	0	0	0	0	0	0
Nitrate mg/1	0.88	0.88	11	15.40	13.2	26.4
Phosphate mg/1	0.04	0.02	0.8	0.5	0.3	X2

5. Sual, Pangasinan

Ecological Factors	Aug. 16	1981 Oct. 18	Dec. 20	Feb. 21	1982 Apr. 18	June 20
Temperature °C	24	32	30	28	29.5	32
Salinity ppt	20	22.5	17	28	30	29.5
pH	7.85	6.5	7.95	8.2	8.2	8.2
Turbidity FTU	0	0	0	0	0	0
Nitrate mg/1	0.66	0.44	13.2	15.4	13.64	22
Phosphate mg/1	0.05	0.01	1.6	0.25	0.2	X2

6. Sta. Cruz, Zambales

Ecological Factors	Aug. 16	1981 Oct. 18	Dec. 20	Feb. 21	1982 Apr. 18	June 20
Temperature °C	22	32	32	29.5	30	32
Salinity ppt	21.5	23.5	17	28.5	31	29.5
pH	7.1	8.2	8.0	8.3	8.1	8.1
Turbidity FTU	0	0	0	0	0	0
Nitrate mg/1	0.88	0.44	13.2	15.4	11	30.8
Phosphate mg/1	.05	Z0.01	0.8	0.35	0.3	X2

7. Orion, Bataan

Ecological Factors	Aug. 22	1981 Oct. 24	Dec. 26	Feb. 26	1982 Apr. 23	June 25
Temperature °C	30	29	31	28	30	29
Salinity ppt	19	21	16	27	30	28.5
pH	7.6	8.0	7.7	7.9	8.1	8.2
Turbidity FTU	0	0	0	0	0	0
Nitrate mg/1	0.044	0.44	13.2	19.8	13.2	26.4
Phosphate mg/1	Z0.01	0.02	0.9	0.6	0.35	X2

8. Manila, Metro Manila

Ecological Factors	Aug. 22	1981 Oct. 24	Dec. 26	Feb. 26	1982 Apr. 23	June 25
Temperature °C	30	34	28	27	29.5	31
Salinity ppt	19	20	15	26.5	30	29.5
pH	6.9	7.25	7.9	7.8	8.2	7.9
Turbidity FTU	0	0	0	10	0	0
Nitrate mg/1	22	0.88	15.40	15.40	15.40	15.40
Phosphate mg/1	0.01	0.02	0.42	0.2	0.45	0.4

9. Noveleta, Cavite

Ecological Factors	Aug. 23	1981 Oct. 25	Dec. 27	Feb. 27	1982 Apr. 24	June 26
Temperature °C	29	30	27	26	30	28.5
Salinity ppt	24	22.5	16	29	31	25
pH	7.1	8.0	7.8	8.0	8.1	7.9
Turbidity FTU	0	0	0	0	0	0
Nitrate mg/1	3.08	0.44	17.6	19.8	15.4	9.68
Phosphate mg/1	0.05	0.02	0.4	0.25	0.3	X2

10. Balayan, Batangas

Ecological Factors	Aug. 23	1981 Oct. 25	Dec. 27	Feb. 27	1982 Apr. 24	June 26
Temperature °C	32	29	28	26.5	29	29
Salinity ppt	20	23.5	16	29	32	29
pH	7.0	8.0	7.95	8.0	8.2	8.2
Turbidity FTU	0	0	0	0	0	0
Nitrate mg/1	2.64	0.44	13.2	13.2	12.32	13.2
Phosphate mg/1	0.04	0.01	0.9	0.25	0.3	X2

11. Calapan, Oriental Mindoro

Ecological Factors	Aug. 29	1981 Oct. 31	Dec. 28	Feb. 28	1982 Apr. 25	June 27
Temperature °C	29	29	26	27	29.5	28
Salinity ppt	22.5	22.5	17	28.5	31	27.5
pH	7.95	7.95	7.95	8.2	8.1	7.4
Turbidity FTU	0	0	0	0	0	0
Nitrate mg/1	26.4	26.4	13.2	19.8	11	22
Phosphate mg/1	0.05	0.15	0.9	0.25	0.25	X2

12. San Jose, Occidental Mindoro

Ecological Factors	Aug. 30	1981 Oct. 31	Dec. 28	Feb. 28	1982 Apr. 25	June 27
Temperature °C	21	30	29	27	30	29
Salinity ppt	21	21	17	29.5	31	29
pH	7.9	8.1	7.95	8.2	8.1	7.9
Turbidity FTU	0	0	0	0	0	0
Nitrate mg/1	26.4	0.44	13.2	15.4	13.2	26.4
Phosphate mg/1	0.01	0.02	0.9	0.3	0.4	X2

Table 5

Summary Table of Correlation and Stepwise Regression Showing the Variables Affecting Phytoplankton Cell Count

Station	Variable	r Value
1. Basco, Batanes	4 & 5	+.894
2. Burgos, Ilocos Norte	0 & 5	+.910
	1 & 4	+.834
3. Sta. Maria, Ilocos Sur	4 & 5	+.962
4. Agoo, La Union	4 & 5	+.894
5. Sta. Cruz, Zambales	0 & 2	+.863
	1 & 3	+.894
	4 & 5	+.931
6. Orion, Bataan	0 & 3	+.808
	2 & 3	+.817
	4 & 5	+.869
7. Manila, Metro Manila	0 & 3	+.924
	0 & 5	+.970
	3 & 5	+.929
8. Noveleta, Cavite	0 & 4	+.847
9. Calapan, Oriental Mindoro	3 & 5	+.878
10. Sual, Pangasinan		< +.811
11. Balayan, Batangas		< +.811
12. San Jose, Occidental Mindoro		< +.811

Variables: 0 = Total Cell Count

1 = Temperature

2 = Salinity

3 = pH

4 = Nitrates

5 = Phosphates

Required r for significance at .05 level = .811

Table 6

THE MARINE PHYTOPLANKTON IDENTIFIED IN THE TWELVE STATIONS

MARINE PHYTOPLANKTON	COLLECTING STATION											
	1	2	3	4	5	6	7	8	9	10	11	12
Bacteriastrum delicatulum			x	x				x		x	x	x
B. hyalinum				x							x	
B. varians		x	x	x	x	x	x	x	x	x	x	x
Bellerochea malleus						x			x	x	x	
Biddulphia aurita	x								x			
B. dubia	x	x										
B. mobiliensis			x	x	x	x	x	x	x	x	x	x
B. pulchella	x	x	x			x	x		x		x	
B. sinensis	x	x	x	x	x	x	x	x	x	x	x	x
Cerataulina bergoniix						x	x	x	x	x	x	x
Ditylum sol		x	x	x	x	x	x	x	x	x	x	x
Hemiaulus sinensis	x					x	x		x		x	x
Triceratium americanum						x						
T, favus		x		x								
Chaetoceros affinis								x		x		
C. cocretatus			x	x	x	x	x			x	x	x
C. compressus					x							
C. convolutus						x						
C. danicum	x		x	x	x	x	x				x	
C. decipiens	x	x	x	x	x	x	x	x	x	x	x	x
C. densus											x	
C. elbenii										x		
C. laevis		x	x	x			x			x	x	x
C. lorenzianus		x		x	x						x	x
C. messanensis												x
C. paradoxum	x	x	x	x	x		x				x	
C. pelagicus				x								
C. peruvianus			x							x		
C. socialis			x									
C. teres			x	x	x							x
Coscinodiscus asteromphalus						x					x	
C. excentricus											x	
C. granii						x	x		x	x	x	x
C. janesianus									x			
C. nitidus						x			x			
C. nonilis					x							
C. oculus-iridis		x	x			x	x		x	x	x	
C. radiatus	x	x	x	x	x	x	x	x	x	x	x	x
Planktoniella sol		x	x		x		x	x	x		x	
Eucampia zoodiacus	x					x	x				x	x
Leptocylindrus danicus					x						x	x
Melosira borreri		x	x		x	x			x	x		x
Rhizosolenia alata	x	x	x	x	x	x	x	x	x	x	x	x

	1	2	3	4	5	6	7	8	9	10	11	12
R. alata forma ***gracilima***											x	
R. alata forma ***indica***											x	
R. bergonii											x	
R. calcar-avis											x	
R. castracanei											x	
R. fragilissima			x	x	x		x	x	x		x	x
R. hebetata forma ***hiemalis***			x		x						x	x
R. hebetata forma ***semispina***											x	
R. robusta											x	
R. stoltherfothi		x	x	x	x	x					x	
R. styliformis		x	x	x	x	x	x	x	x		x	x
R. styliformis var. ***latissima***											x	
Skeletonema costatum		x	x	x	x	x		x	x	x	x	x
Lauderia annulata				x								
L. borealis							x	x				
L. glacialis												x
Thalassiosira subtilis											x	
Achnanthes brevipes		x						x	x	x		
Cocconeis scutellum		x							x			
Asterionella japonica		x	x	x				x		x		
Fragilaria oceanica forma ***typica***		x								x		x
Thalassionema nitzschioides		x	x	x	x	x	x	x	x	x	x	x
Thalassiothrix fraunfeldii		x	x		x	x	x		x	x	x	
T. longissima		x	x		x	x	x			x	x	x
Navicula elegans							x	x				
N. salinarum		x					x			x		
Pleurosigma affine	x	x	x	x		x	x	x	x	x	x	x
Bacillaria paradoxa	x	x			x	x	x			x	x	x
Nitzschia lanceolata	x								x			
N. longissima	x	x	x	x			x			x		x
N. seriata	x		x				x	x	x	x	x	x
Campylodiscus ralfsii										x	x	
C. undulatus					x	x			x	x		
Surirella cuneata										x	x	
Climacosphenia monaligera	x		x		x	x						
Licmophora abbreviata	x				x							
L. flabellata						x						
Rhabdonema adriaticum	x				x	x						
R. arcuatum						x						
Striatella unipunctata	x	x										
Ceratium breve							x			x	x	x
C. candelabrum											x	
C. extensum		x	x	x	x	x	x			x	x	
C. furca			x				x			x	x	x
C. fusus					x	x	x					
C. gibberum		x										
C. kofoidii						x						
C. longinum						x						
C. macroceros		x	x	x	x	x	x			x	x	

	1	2	3	4	5	6	7	8	9	10	11	12
C. massiliense							x					x
C. pentagonum						x					x	
C. pulchellum							x					
C. setaceum												x
C. sumatranum									x			
C. teres											x	
C. tripos			x			x	x			x	x	x
C. vultur					x							
Ceratocorys horrida						x					x	
Peridinium faltipes											x	
P. oceanicum			x		x	x	x				x	
P. parallelum							x			x	x	x
P. pentagonum											x	
Pyrophacus horologicum					x	x	x			x	x	x
Ornithocercus serratus											x	

Note:

x *indicates the presence of phytoplankton in the collecting station.*